



est. 1878

USER- MANUAL TLC10-3

Tamson Instruments B.V.

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THE NETHERLANDS
Rev. 1.03UK 5-2013

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1 SAFETY AND WARNINGS

Make sure before installing or operating the equipment to read and understand all instructions and safety precautions listed in this manual. If there are any questions concerning the operation of the equipment or about the information given in this manual please contact your local dealer or our sales department first.

Performance of installation, operation, or maintenance other than those described in this manual may result in a hazardous situation and may void the warranty of the manufacturer.

Never operate equipment that is not correctly installed. Unqualified personnel must not operate the equipment. Avoid damage to the equipment, or its accessories, caused by incorrect operation.

Important:

- When performing service, maintenance or moving the apparatus, always disconnect the line cord of the apparatus,
- Proper skilled and trained personnel are only allowed to operate this equipment,
- Take notice of warning labels and never remove them,
- Refer service and repairs to qualified technician,
- If a problem persists, call your supplier or Tamson Instruments B.V.

2 WARRANTY

Tamson Instruments B.V. warrants that all their manufactured equipment is free from defects in material and workmanship, preventing the machine from normal operation. Tamson Instruments B.V. does not warranty that the equipment is fit for any other use than stated in this manual. The manufacturer can only be held responsible for the security, reliability and performance of the equipment, when operated in accordance with the operating instructions, extensions, adjustments, changes and/or if repair is performed by Tamson Instruments B.V. or authorized persons only. This warranty is limited to one year from the date of invoicing. All equipment and materials are subject to standard production tolerances and variations.

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3 EC DECLARATION OF CONFORMITY

Manufacturer: Tamson Instruments bv
van 't Hoffstraat 12
2665 JL Bleiswijk
The Netherlands

Product: Thermostatic bath and circulator

Model: TLC10-3

We declare that the product mentioned above conforms to the essential's exigency of the directive 2006/42/EC relative to machinery, directives 2004/108/EC relatives to electromagnetic compatibility and directive 2006/95/EC relative to low voltage.

The products are in conformity with the following specifications:

EMC (2004/108/EG)

Conducted emission	- EN55016-2-1 + EN61326+A1
Radiated emission	- EN55016-2-3 + EN61326+A1+A2+A3
Harmonics	- EN61000-3-2
ESD	- EN61326 +A1+A2+A3 and EN61000-4-2 +A1+A2
Radiated immunity	- EN61000-4-3 +A1
Electrical Fast Transients	- EN61000-4-4+A1+A2
Surges	- EN61000-4-5+A1
Conducted immunity	- EN 61000-4-6+A1
Voltage dips and Voltage variations	- EN61000-4-11 +A1

Low voltage (2006/95/EC):

Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1,
General requirements,
EN 61010-1-2010
Safety requirements for electrical equipment for measurement, control, and laboratory use Part 2,
Particular requirements for laboratory equipment for the heating of material,
EN 61010-2-010-2003

Machinery directive (2006/42/EC) 2006-42-ec-2nd-2010

2013, Tamson Instruments bv, The Netherlands,

Name : R.C. van Hall
Function : Director

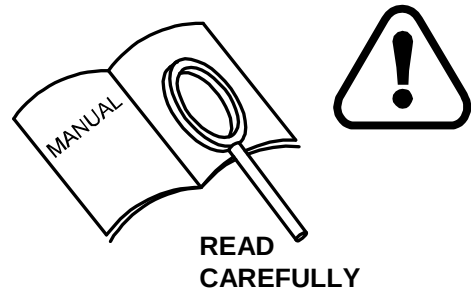
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4 PRECAUTIONS AND HAZARDS

Before attempting to operate the bath read all parts of this manual carefully to insure smooth operation and avoid damage to the equipment or its accessories.

If a malfunction occurs, consult section "Trouble shooting", page 24

If problem persists, call your supplier or Tamson Instruments B.V. Never operate the equipment if not correctly installed. The equipment must be operated only by qualified personnel. Avoid damage to the equipment or its accessories through incorrect operation.



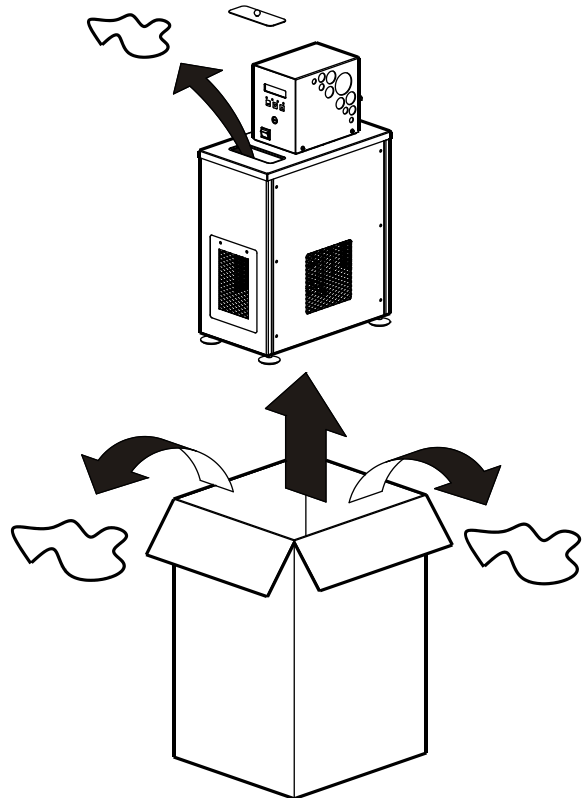
5 INSTALLATION

Tamson Instruments B.V. is not responsible for any consequential damage or harm caused by using this bath. Repairs on the electrical system of the bath may only be carried out by well trained and authorized persons.

5.1 Unpacking

To avoid damage during transport all Tamson baths are carefully packed for shipment. Check the packaging for external damage and make a note on the shipping documents if any damage is found. Always retain the cartons and packing material until the bath has been tested and found in good condition. Transport companies generally will not honor a claim for damages if the respective box is not available for examination. The shipment contains at least the bath/circulator. The consignment may contain other parts, individually packed in small boxes. Please see packing list for details concerning total contents of consignment.

Before filling the bath remove any remaining packing material from its interior. The interior of the bath can be accessed by taking off the lid on the top of the bath.



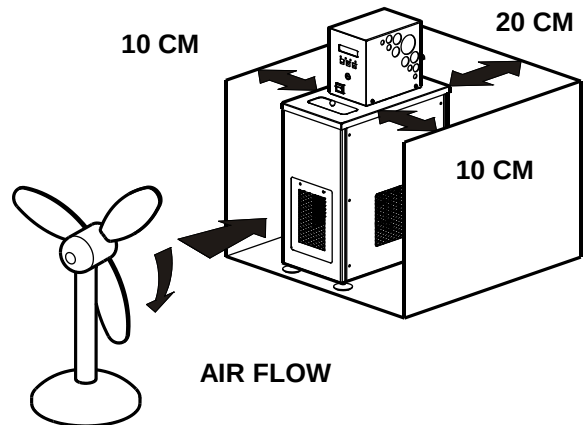
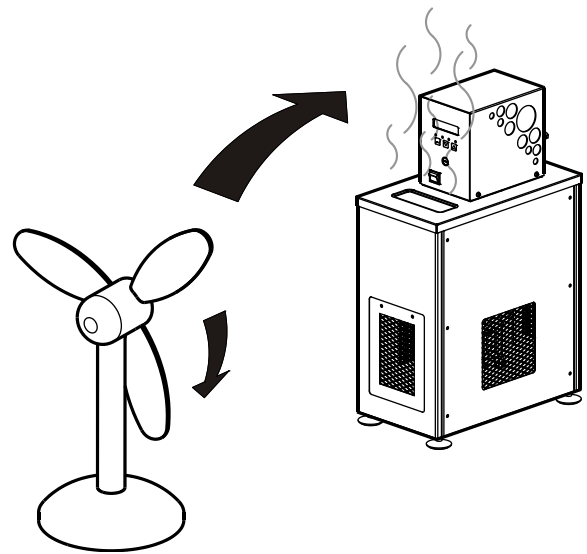
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5.2 Placement and ventilation

The bath has to be placed in a well ventilated area.

Do not place the bath in a dusty environment. Dust will block the condenser unit inside the apparatus which will lead to severe mechanical damage.

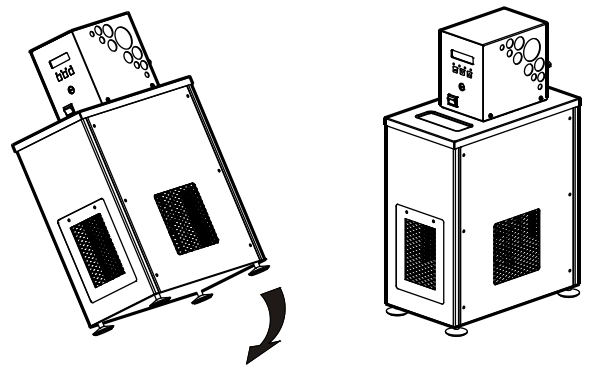
Air circulation has to be enabled by 10 cm of free space at both sides and 15 to 20 cm at the rear of the bath.



5.3 Initial use

Due to transportation allow the bath a 24 hour period for stabilization. This applies also when the apparatus has been tilted or fallen.

Do not switch on power, because lubrication-oil inside the compressor system has to run into the capillary. It will take several hours before the oil has flown back into the compressor unit. When the apparatus is immediately turned on after it has been tilted, severe damage may occur to the compressor unit due to insufficient lubrication.

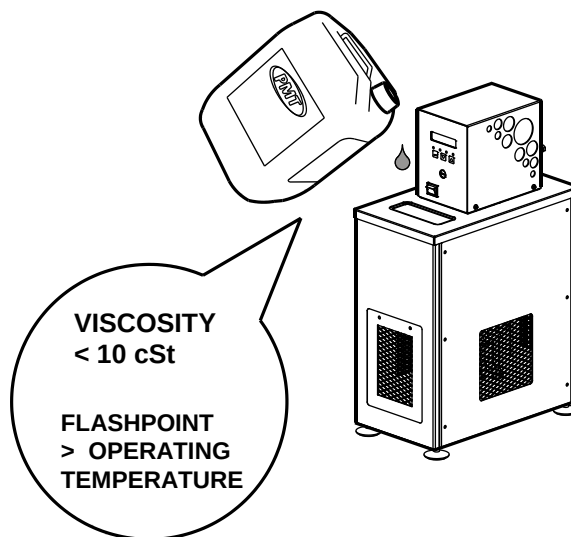


5.4 Bath liquids

The bath must be filled with a liquid suitable for the minimum operating temperature.

It is very important to select a liquid with a viscosity of less than 10 cSt at the operating temperature and a flash point which is well above the operating temperature.

Do not use demineralized water. This water can lead to corrosion of the bath and moving parts. The corrosion can wear out the pump bearings. Osmosed water can be used instead.



As bath liquid methanol or anti freeze (mixture of water and ethylene-glycol) can be used. Do not use demineralised or tap water at temperatures below 5°C/41°F.

Methanol is extremely flammable and can cause fire hazard. Take all necessary precautions to reduce fire hazard. When using methanol all vapors must be removed by using appropriate air ventilation.

Methanol is toxic and can cause health risks. Use appropriate ventilation and other precautions to prevent inhaling toxic vapors. If ventilation is insufficient the risk of explosion hazards can occur!

The supplier of the bath liquid (methanol) will be able to hand over all chemical details and safety precautions related to the use of methanol. These precautions must be followed when operating the bath.

As alternative to methanol a mixture of water and anti-freeze (ethylene-glycol) can be used.





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Working temperature [°C]	Mixture (volume percent)
5	90% water, 10% ethylene-glycol
0	80% water, 20% ethylene-glycol
-10	70% water, 30% ethylene-glycol

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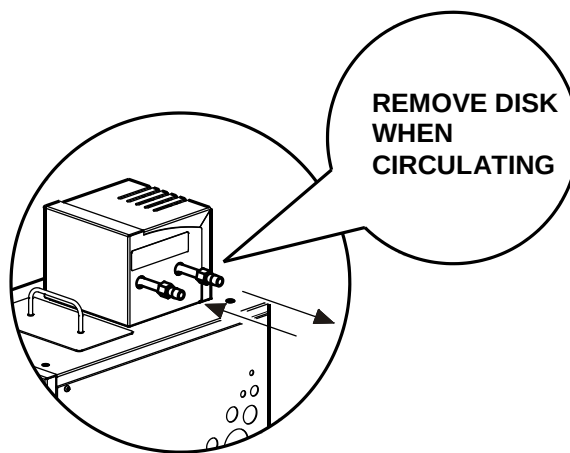
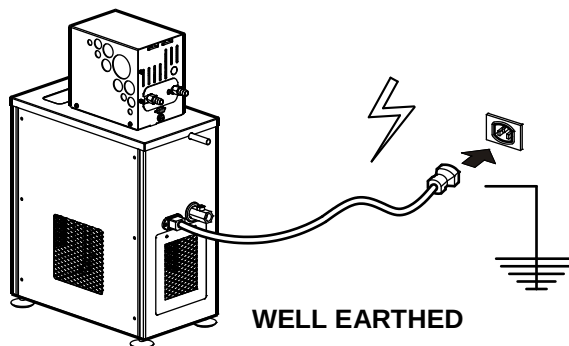
6 CONNECTING

Before plugging the cooler into the mains socket, make sure the voltage of the bath corresponds to the local voltage and frequency.

Use a mains supply that is well earthed, clean of interference and suitable for the acquired electrical load of the bath.

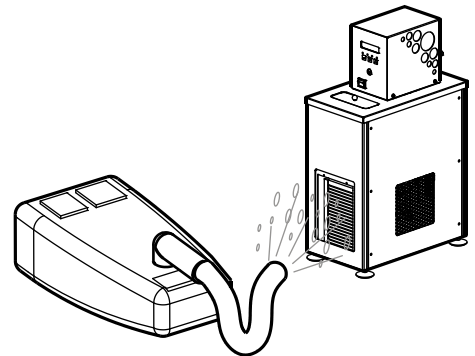
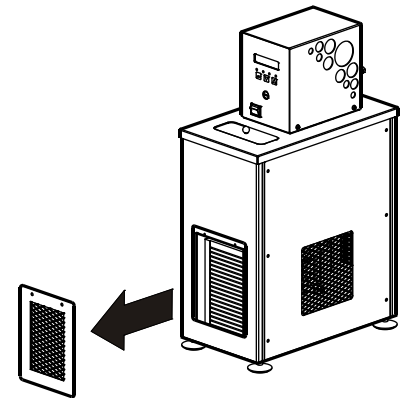
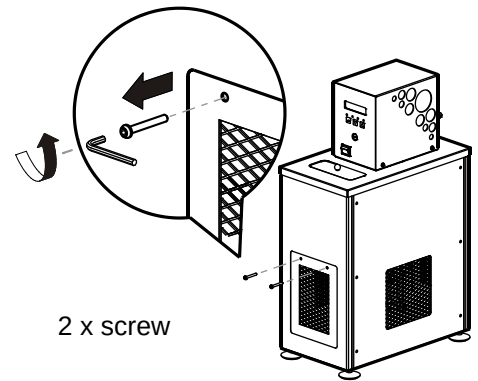
The inlet and outlet of the pump are fitted with 8..10 mm hose connections and 1/4" threaded fittings for metal tubing. The outlet (most near to the backside of the apparatus) is provided with a small disc, stopping the circulation action.

Before the fluid can begin circulating through external systems this disc must be removed by unscrewing the fitting and hose connection removing the disc.



6.1 Cleaning

Regularly check the apparatus and condenser unit for dust. Remove dust with a vacuum cleaner.



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7 INTRODUCTION TO THE TLC SERIES

The TAMSON model TLC circulators are designed to perform accurate temperature control required for general laboratory. The Tamson circulator is optimized for temperature control of applications requiring a high degree of stability over a broad temperature range.

7.1 General

The TLC apparatus consists of a combination of a cooling system and a microprocessor controlled heating element. This design ensures a high degree of accuracy and reproducibility of temperature controls.

The TAMSON baths are constructed throughout from corrosion-resistant – stainless steel and Teflon – materials. The bath is effectively insulated against heat loss by a layer of Armaflex® rubber between the inner tank and outer casing.

7.2 Pump

A circulation pump is built-in to guarantee an uniform temperature distribution within the bath and providing the possibility to circulate through a closed external system.

Standard pump: a circulation pump is provided with a capacity of 7 liters / min and a max pressure of 2,7 m head of water [2,7mtr H₂O or 270 mBar].

7.3 Temperature control

Temperature control and setting the bath temperature is regulated using a PT-100 temperature probe Class A connected to a microprocessor module. The advanced electronic control system continually computes the energy input required for optimal temperature accuracy and stability. Temperature read-out is on a 2 x 16 character LCD. The actual set point is computed within the controller with an accuracy of 0.001°C.

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8 OPERATION

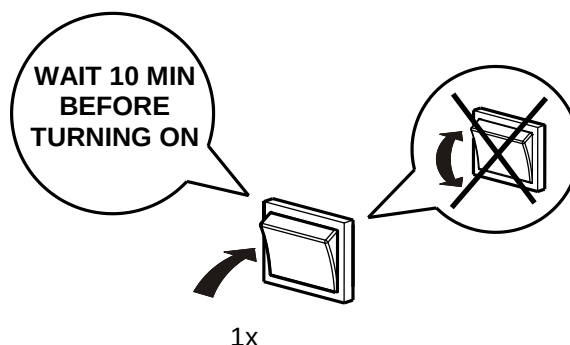
8.1 Switching on

If the bath has been properly filled with fluid it can be switched with the mains switch located on the front panel. Chose a working temperature (set point).

8.2 Caution with powering on/off

Be careful and do not toggle with the on/off switch. To start the cooling compressor high currents are needed which will heat the compressor motor internally. Switching off and on the compressor several times will lead to mechanical damage.

When switching off the apparatus, wait for 10 minutes before switching the system back on again.



8.3 Safety systems

In case of electronic failure the possibility exists that the heater element is continuously switched on. This will cause extreme temperature rise. To prevent high temperatures the bath is fitted with a mechanical over-temperature protection thermostat. This thermostat will switch-off the bath at a pre set temperature in the range from 50 to 270°C.

We advise to adjust the mechanical over temperature to approximately + 25°C above the bath set point.

This safety construction prevents for example oil to be heated above flaming-point which will cause fire or prevent evaporation of bath fluid due to high temperatures.

The thermostat will automatically reset when the bath temperature drops approximately 10°C below the pre-set temperature. To continue normal operation the bath has to be switched off and on again.

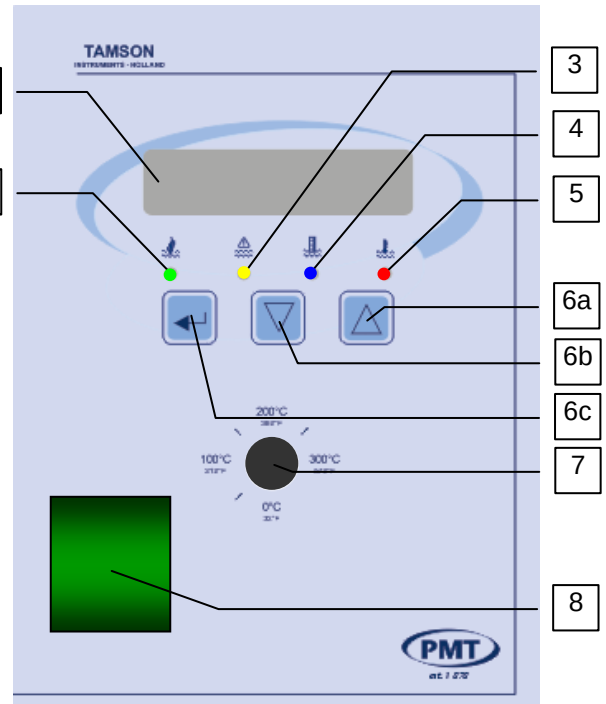
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8.4 Adjusting the mechanical over-temperature protection thermostat

Turn the thermostat clockwise (7 drawing 1) to its maximum. Be aware that the safety thermostat is now only functioning at 270 °C. Heat the bath to the appropriate set point. Gently turn the thermostat anti-clockwise, until the over-temperature protection is activated, and system switches off. Turn the thermostat approximately 30°...40° higher (turn clockwise). Switch the bath off and on again. The bath is ready to operate safely.

8.5 Control Panel

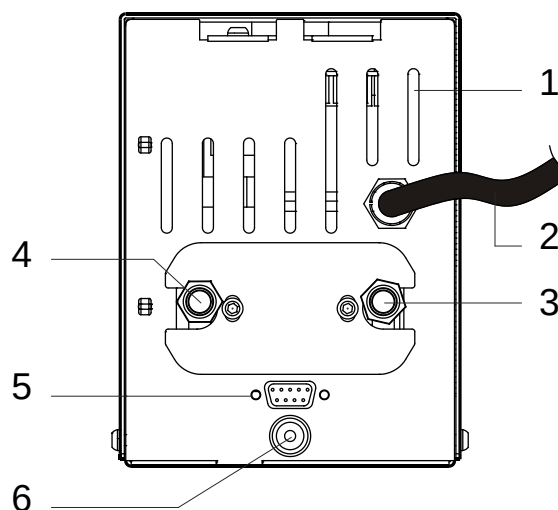
- 1 LC Display
- 2 Heater indicator (Green)
- 3 Error (Yellow)
- 4 Level indicators (Blue)
- 5 Over temperature indicator (Red)
- 6 Up(a), down(b), enter(c) buttons
- 7 Over-temperature protections
- 8 Mains switch



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8.6 Backside apparatus

- 1 Cooling sleeves,
- 2 Power cord,
- 3 Return pump diameter 1/4" outer straight BSP-gas fitting with connection for hose (8mm inner diameter),
- 4 Pressure side pump 1/4" outer straight BSP-gas fitting with connection for hose (8mm inner diameter),
- 5 RS232 communication port (Sub-D female 9-pole),
- 6 Motor protection fuse.



8.7 Front panel keys

The front panel layout shows the following operating keys:

The "Page" Key offers following:

- Temperature readout in °C,
- Temperature set point in °C,
- Tuning the bath ("A-tune"),
- Changing the tuning (PID) parameters,

The "Up and Down" keys allow changing the listed value. All changed values like set point and PID parameters will be kept in memory even after switching of the power supply.

PAGE



DOWN



UP

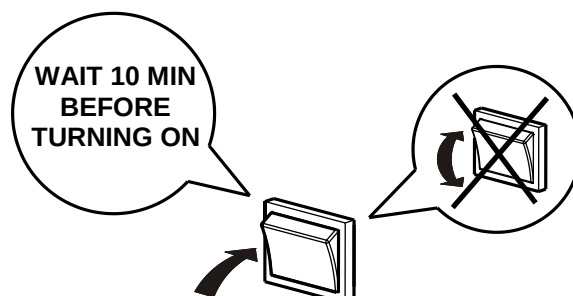


9 OPERATING THE SYSTEM

When the bath is ready for use it can be switched on by pressing the mains switch.

When switching off the apparatus, wait for 10 seconds before switching the system back on again.

The electronics are suited for both 50 and 60 Hz.



The front panel layout shows the following 3 operating keys:

Page



Down



Up



- Set point ←
- Offset** (press: <-5.00 .. +5.00°C step 0.01°C)
- Max Power (press: low, med, hi, max)
- Boost heater (press on / off)
- Time const (press: fast, medium slow, precise)
- Stirrer *
- Low alarm *
- High alarm *
- PID parameter:
(PID set 1, PID set 2, PID set 3, PID set 4)
Proportional band ($P_b = 1/P$ where P is proportional value)
Integral value
Differential value
- Backlight
- Temp units
- Baudrate



* optional

** This value is added to the measured temperature by the microcontroller. This way the temperature readout can be synchronized with an external calibrated measuring device like the TT3.

note: ☞ Display switches back automatically to temperature readout. Changed values are stored. Or Press  to confirm when settings are altered.

☞ Each time  is pressed another option is displayed.

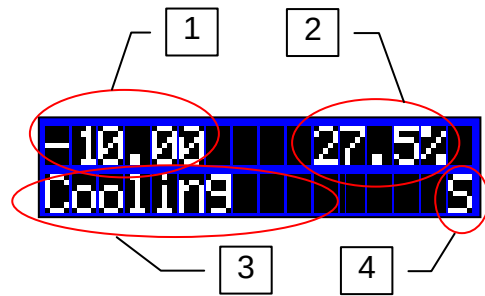
Up and **Down** keys allow changing the listed value. All changed values, like set point and PID parameters, will be kept in memory when pressing the page key to leave the menu. After switching off the power supply, changed values are kept in memory.



The Tamson Thermometer "TT3". This can be used as an external calibrated temperature read out.

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9.1 Display readout



- 1 Temperature readout
- 2 Applied percentage of power
- 3 Operating mode
- 4 Indicator, alarm high, alarm low, control stable

Ad 1: When the controller starts or is restarted, the displayed value increases to a stable readout appears after a few seconds.

Ad 2: The controller calculates every second the amount of power which should be applied for stable control. The value is displayed with a resolution of 0.1% and ranges from 0% to 99.9%.

Ad 3: Boost Bath is heating to set point
 Cooling Bath is cooling down to set point
 Tuning Ratio Bath is tuning for power needed
 Tuning SA Bath is tuning, second step
 PID SP=25.00 Bath is controlling, set point is 25.00°C (example)

Ad 4:

-  Bath control is stable
-  Alarm high, press button to reset
-  Alarm low, press button to reset

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9.2 Quick start, adjust set point

To start operating the bath:

Fill the bath with sufficient fluid* to flood the cooling coil, However do not fill the bath fully to the maximum.

Place the power plug, switch the bath on using the mains switch,

Choose a working temperature (set point):

Press  once. Display will indicate "SP.1". Alter set point temperature by using up  and down  key to select the desired bath temperature. Press  to confirm and display bath temperature again.

9.3 Tuning

Tuning can be done manually. The parameters mentioned in Table 1 will influence the control of the bath.

The PID parameters are set to

P	I	D
25	16	0

These parameters work fine for following bath contents:

- Water
- Water / Glycol
- Silicone oil, < 10cSt @ 25°C
- Mineral oil, < 10cSt @ 25°C

9.4 Manual tuning

The parameters for the PID control can also be changed manually. The control also allows to set the I and D values to zero. The bath will then function as a proportional system. The "P" parameter can then be varied to an optimal value by trial and error. A higher P will stabilize the system when I and D are off. The PID parameters can also be determined with the use of the Ziegler Nichols method described below.

Manual tuning by Ziegler-Nichols

With the process at its normal running temperature:

Set the integral time "Ti" and the derivative Time "Td" to off

Ignore the fact that the temperature may not settle precisely at the set point

If the temperature is stable, reduce the proportional band Pb so that the temperature just starts to oscillate. If the temperature is already oscillating, increase the proportional band until it begins oscillating. Allow enough time between each adjustment for the loop to stabilize. Make a note of the proportional band value "B" and the period of oscillation "T" Set the Pb, Ti and Td parameter values according to the calculations given in the table below

Type of control	Proportional band	Integral time "ti"	Derivative Time "td"
Proportional only	2xB	Off	Off
P + I control	2,2xB	0,8xT	Off
P + I + D control	1,7xB	0,5xT	0,12xT

10 MENU ITEMS

Use the front panel buttons  and  to select a menu. After pressing  a  sign appears next to the value indicating the value can now be changed. Pressing the up or down button again activates the value immediately. When the value is changed the value can be accepted by pressing . The new value will be stored accepted. When not pressing  the value will be stored automatically after 5 seconds. The display then returns back to normal operating mode.

10.1.1 Menu item "Setpoint"

Select the set point temperature. Resolution is 0.01°C +/- the system accuracy.

10.1.2 Menu item "Offset"

The temperature displayed can be increased or decreased with an offset ranging from +5.00 down to -5.00 °C in steps of 0.01°C. This way the temperature reading on the display can be synchronised with an independent separate thermometer.

10.1.3 Menu item "Max Power"

(press: low 25, med, hi, max)

Limits the applied power by a maximum value:

Low	Maximum of 25% applied
Medium	Maximum of 50% applied
High	Maximum of 75% applied
Maximum	100% power is applied

10.1.4 Menu item "Boost heater"

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No boost heater mounted, inactive
(A secondary heater is used to quickly heat up the bath.
This menu item enables or disables the heater.
Standard value: On)

10.1.5 Menu item "Time const"

Used to select time to tune. The option precise has to be used to reach maximum temperature accuracy. Options are:

- Fast	60 seconds
- Medium	120 seconds
- Slow	180 seconds
- Precise	240 seconds
Standard value:	Precise

10.1.6 Menu item "Stirrer"

Inactive
(Stirrer 0 .. 100% (step 6%). Inactive)

10.1.7 Menu item "Low alarm"

min SP to max SP. resolution 0.1°C. No hardware connected, display only

10.1.8 Menu item "High alarm"

Min SP to max SP. resolution 0.1°C. No hardware connected, display only.

10.1.9 Menu item "PID parameter"

PID set 1	
PID set 2	- deactivated
PID set 3	- deactivated
PID set 4	- Activated when communication via RS232

Each set offers independent PID settings for:

Proportional band
Integrating
Differentiating

Default settings

Pb*	:=	25
I	:=	16
D	:=	0

*Pb= proportional band. Proportional value P is found to be 100/Pb.

10.1.10 Menu item "Backlight"

On
Off



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Standard value: On

10.1.11 Menu item "Temp units"

°C

°F

Standard value: °C

10.1.12 Menu item "Baudrate"

300

600

1200

2400

4800

9600

19200

38400

Standard value: 9600

10.1.13 Menu item "Restart"

Restarts system and activates tuning.

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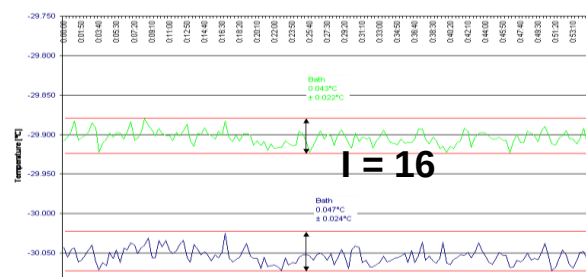
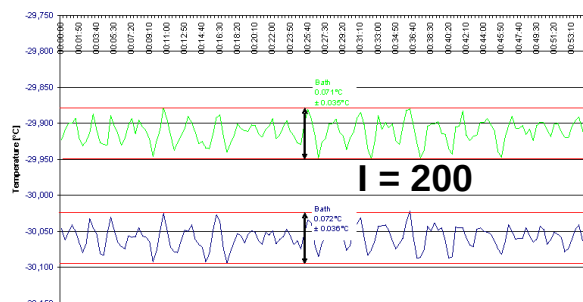
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10.2 PID configuration

The two graphs below show the influence of the integral setting. The graph on top has a setting of 200 for the integral parameter. The bottom graph has a setting of 16. The value of 200 causes less stable control.



10.3 Manual tuning

The temperature control of the bath is based on a digital PID system. When using different fluids in the bath each with their own heat capacity, the use of external cooling and external connected processes (circulation), or working at different set point temperatures requires new settings of the PID parameters. These parameters have to be optimized after changes to the system when optimal and accurate temperature control of the bath liquid is required.

Tuning of the bath results in:

- Stable temperature control of the bath,
- No over- or undershoot of the temperature set point,
- Quick response to deviations from the set point caused by external disturbances.

Tuning can be done automatically or manually.

Parameter	Description	Display
Proportional band	The bandwidth in display-units over which the output power is proportional between minimum and maximum	P
Integration time	Determines the time taken by the controller to remove steady state error signals	I
Derivative time	Determines the time taken by the controller to react on error signals.	D

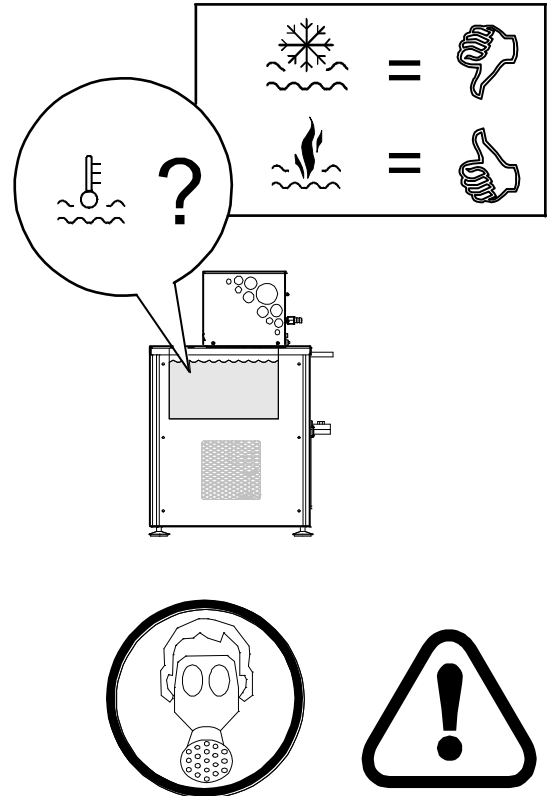
Table 1 Parameters influencing the temperature control

10.4 Draining bath fluid

Before removing flammable bath liquids take the appropriate fire hazard precautions against these liquids.

Do not remove cold bath liquid. Cold liquid can cause severe burning when spilled. Preheat the bath liquid back to ambient temperature before removing.

When removing bath fluid do not inhale toxic vapor. Always use appropriate ventilation.

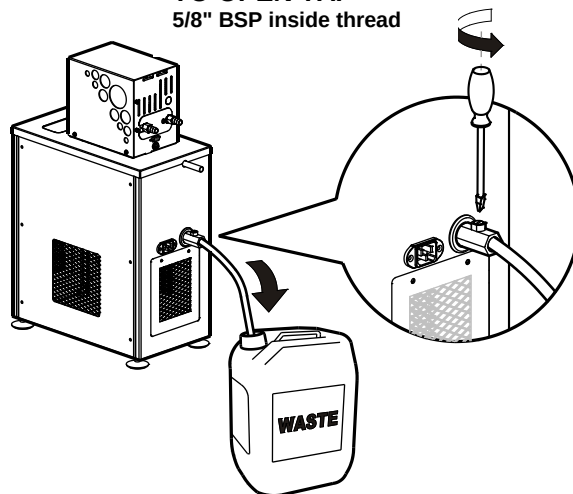


10.4.1 Using the drain tap

The TLC baths can be drained via the drain tap located at the backside of the apparatus.

For safety reasons the tap can only be opened by using a screwdriver. The thread inside the tap is 5/8".

**USE SCREWDRIVER
TO OPEN TAP**
5/8" BSP inside thread



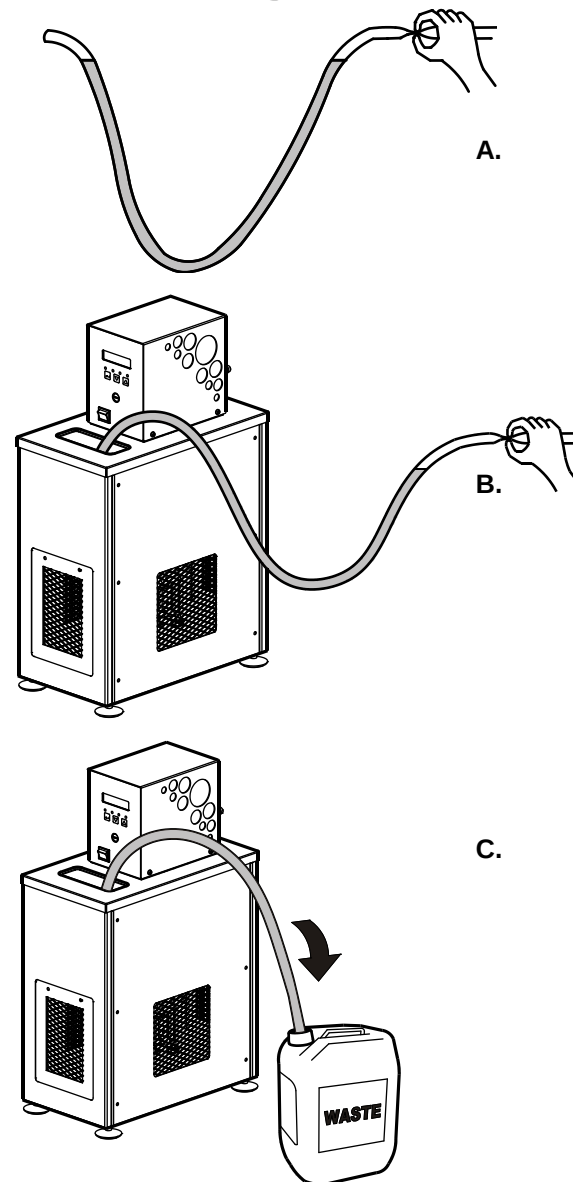
10.4.2 Fast method: drain by hand

The bath fluid can easily be removed by using a length of hose. Length of approximately 1.5 mtrs and 10 mm inner diameter.

Handle as follows:

Fill the hose with fluid ("A"),

- Close one side of the hose and immerse the other end in the bath ("B"),
- Lower the closed end into a waste bucket and let the bath fluid flow ("C"),
- Remove the last pieces with a sponge or tissue,
- Refill the bath approximately 1 cm below the lid.



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10.5 Maintenance

Keep the apparatus free from dust. Regularly check the cooling openings and remove dust with a vacuum cleaner. If necessary remove cover and clean internally. Use appropriate protection when cleaning, dust can be very unhealthy.

11 TROUBLE SHOOTING

11.1 General

The motor is not running and the lamps are not on.	Check the main voltage and all electrical connections, including switches. Check fuse in wall socket of mains supply.
Motor is not running, display and heating are OK	Motor overloaded. The motor protection may trip because of mechanical overloading of the pump. Reset fuse by pushing button on rear side of blue motor housing.
Motor is not running, RED LED blinks on front panel	Over temperature safety has been activated - Switch off bath, - Investigate reason for high bath temperature - Check temperature setting of over temperature device, - Switch bath back on again (wait at least 10 minutes after switching off).
Compressor is making "clicking" noise	Bath has been switched on and off too quickly. Wait approximately 10 minutes before switching on again. The clicking noise is a temperature fuse inside the compressor preventing it from overheating.
Compressor will not start	When the machine has been switched off the pressure in the cooling circuit can rise to a high level. For this reason the apparatus has to settle the pressure of the cooling liquid for several minutes (5 ... 10) before it can be restarted. When this problem occurs more often it will indicate that dust is blocking the condenser circuit. Remove front cap and use vacuum cleaner to remove dust.
Can not set PID values	Disconnect RS232 connection. Select PID parameter set 1.
Temperature not stable	Check and set PID parameters. Default is P = 25 I = 16 D = 0 Place top lid on the bath.

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Temperature does not drop

Bath is not properly insulated. Place top lid on the bath.

Insulate circulation circuit.

Circulation load exceeds heat removal capacity of TLC10.

12 SPECIFICATIONS

12.1 Technical specifications overview

Item	Unit	TLC10
Range	[°C]	+60...-10
Setting $\pm$	[°C]	0,01
Stability* $\pm$	[°C]	0,05
Uniformity* $\pm$	[°C]	0,05
Heater	[W]	1100W
Pressure	[mbar]	270max
Pump Capacity	[L/min]	7 ltr
Bath volume	[L]	3.5
Bath Opening	[mm]	40x114
Opening effective		32x114
Depth	[mm]	150
Length	[mm]	355
Width	[mm]	195
Height	[mm]	410
Weight	[kg]	18
Power (max)	[Watt]	1250
Voltage	00T0050	230V-50Hz
	00T0051	230V-60Hz
	00T0052	115V-60Hz

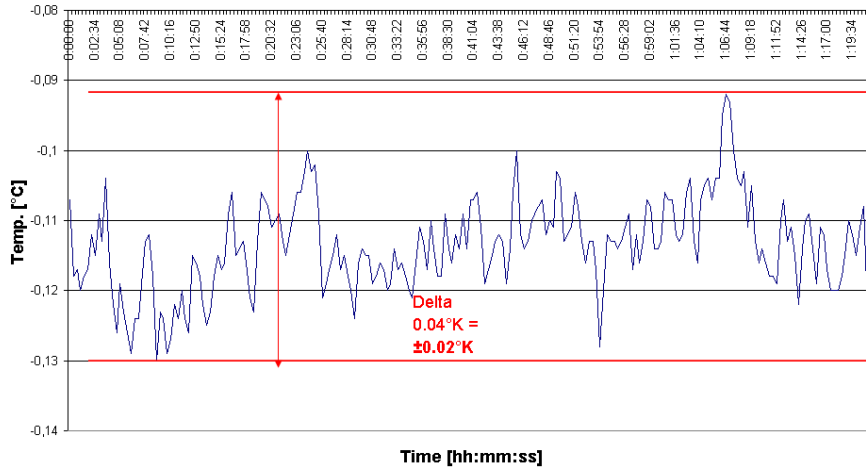
* **Absolute** min/max value measured **over 1hrs** in methanol

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12.2 TLC10-3 performance

12.2.1 Stability

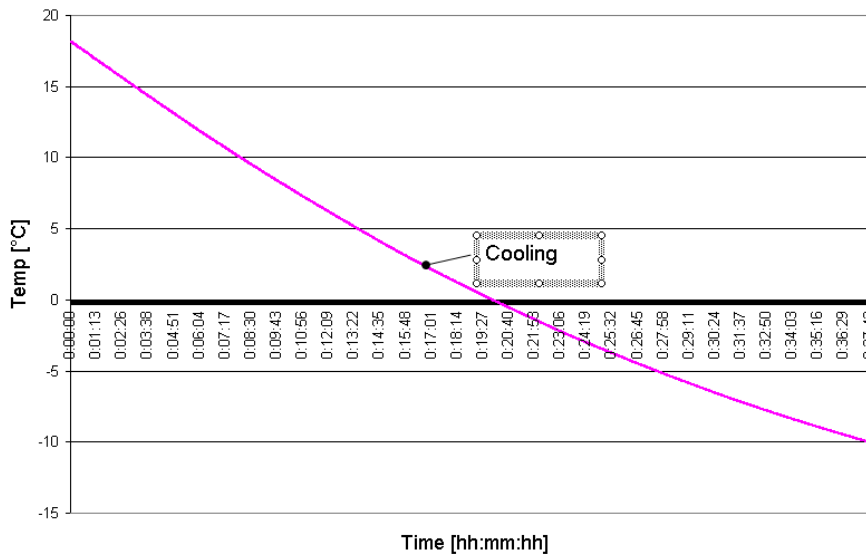
Stability TLC10 [Ref. TLC10-3 Stability.xls]



Bath fluid is methanol

12.2.2 Cool down

TLC10-3 [TLC10-3 Cooldown.XLS] Cool down



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Bath fluid is methanol

Heat removal capacity	
-10°C	50W
0°C	100W
10°C	150
20°C	200
30°C	240
40°C	280
50°C	320

13 RS232 COMMUNICATION

13.1 Commands

When TMC70 selected via menu to communicate at Baudrate 4800 use following settings on PC:

4800
8 data bits
1 stop bit
parity none

ST – returns whether bath is stable or not. State 1 = stable, 0 = not stable. Limits are set with parameters Stable Limit High and Stable Limit Low defined by ASTM D445. So when PV is in the region of $100^{\circ}C > PV < 0^{\circ}C$ Stable Limit High is defined as 0.05. When the average PV deviation (calculated from a sliding window of 255 seconds) is smaller than Stable Limit High, the ST command will return stable(1).

When PV is $0^{\circ}C \leq PV \leq 100^{\circ}C$ and the average PV (calculated from a sliding window of 255 seconds) is smaller than Stable Limit Low, the ST command will return stable(1).

RS - restarts (same as power off-on)

RA – reads raw ADC value, returns 3 bytes binary data, LSB first. This returns the last raw ADC reading. Note that this is updated every 200mS, so reading at a faster rate may return duplicate values. Maximum reading is 0x7FFFFFFF. This command is used for factory calibration/test.

CT <enter> Returns the offset value.

CT <value> <enter> Sets the offset value.

TC – sets/displays time constant in seconds

PL – Power limit in seconds.

BH – returns boost heater on/off state, 0 or 1

BH<n> - sets boost heater state 0/1

CS – Control state – returns state of control algorithm

bits 4..7 represent the main control stages, bits 0..3 are sub-states within each main state

\$00 : control algorithm disabled – allows external PC to take control of heaters

\$10 : startup hold-off started

\$11 : startup hold off in progress

\$12 : startup delay finished, decide to boost or cool

\$20 : boosting

\$30 : Waiting for cool-down

\$40 : Start of ratio process

\$41 : Ratio process in progress

\$42 : waiting for $PV < SP$ -tune offset after ratio

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\$50 : Start of successive approximation process
 \$51 : Successive approximation stabilization delay
 \$52 : Successive approximation in progress
 \$53 : end of successive approximation stage
 \$60 : Proportional mode (subject to change - other values to be defined)

CS<n> Sets state of control algorithm

HP : Returns current heater power percentage

HP<nn> : sets heater percentage to <nn> - this command is only useful if control algorithm suspended with CS command.

AC : Returns 1 when a new temperature value is available, 0 if no new has been measured since the last PV or PVH command. Cleared by PV or PVH command. Used for external PC control synchronization.

PV Returns Process Value with unit, no decimals. 23C or 74F

PVF returns temp as follows :

Use PVF to return a decimal value with 7 decimal digits, e.g.

12.345342C, works for degrees Centigrade, and degrees Fahrenheit. Only first three are significant. When reading is in degree Fahrenheit character F indicates the unit i.e. 73.3961328F

When temperature is negative, minus sign appears i.e. -1.6955468F

PP, returns proportional band value. Proportional band is 100/gain

PI, returns integrating value

PD, returns derivative value

Setting PID:

Range:

Pb = setting 1..999

I= 0..999

D=0..999

PP followed by value, or space and value, will set proportional band. I.E. PP25 will set Proportional band to 25.

PI followed by value, or space and value, will set integrating value. I.E. PI16 will set Integrating value to 16.

PD followed by value, or space and value, will set integrating value. I.E. PD2 will set Derivative value to 2.

The TMC70 contains 4 independent PID sets. Each set can be enabled using the TMC70.EXE program and can have its own name i.e. "water", "silicone oil" or "methanol". **However when the command PP, PI, or PD is used to set a value, automatically set 4 is used. So PID set 4 is reserved for RS232 operation and is activated when approached from RS232.**

SP Set point temperature

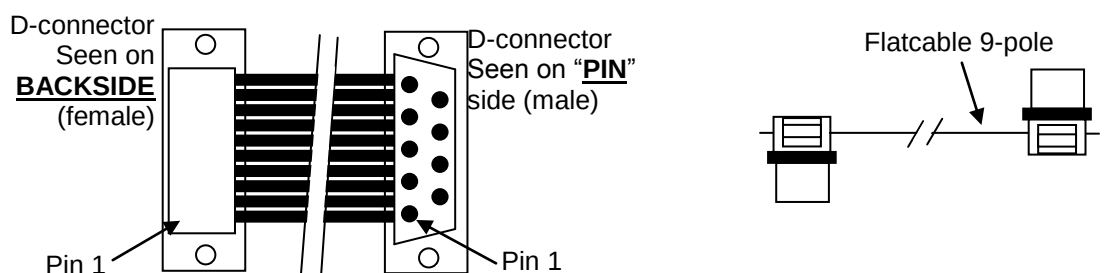
SP, Set point temperature is returned i.e. 20.22

SP22.50 sets set point temperature to 20.50°C

When controller displays temperature in °F, SP20.50 sets the set point to 20.50°F

SP22.555 results in error code "10"

13.2 RS 232 Cable



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14 SPARE PARTS

14.1 TLC10-3

230 Volt 50~60Hz	115 Volt 60Hz	Description
25T1295	25T1301	Motor for pump
25T1343	n. a.	Capacitor 2uF
n. a.	25T1344	Capacitor 7uF
25T1244	25T1245	Fan 120x38mm (Condensor unit)
25T0251	25T0252	Heater 1100 Watts
24T8081	n. a.	Motor fuse 0,3 Amp.
n. a.	24T8080	Motor fuse 0,6 Amp.
06T0514	06T0524	Powerboard PCB TLC-TMC70
25T1101		Compressor 230V-50Hz
25T1106		Compressor 230V-60Hz
	25T1102	Compressor 115V-60Hz
04T1001		Coupling flexible motor axis
24T8581		Mechanical safety thermostat
04T2135		Bearing PTFE
23T0012		Filling valve
24T8545		Mains switch
28T4009		Front foil
25T2310		PT-100 sensor
25T1243		Fan 60x60x25 12VDC (Top compartment)
06T0500		Microcontroller PCB
06T0502		Display PCB
24T8548		Plastic Level detector

n.a. = Not Applicable

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